PATENT SPECIFICATION (11) 1 465 096

1 465 096

(21) Application No. 31440/74 (22) Filed 16 July 1974
(31) Convention Application No. 379 593 (32) Filed 16 July 1973 in
(33) United States of America (US)
(44) Complete Specification published 23 Feb. 1977
(51) INT. CL.² H01R 9/06
H01G 9/00
(52) Index at acceptance
H2E 11 19 2Q
H1M 3B1 3B2E 3B3A 3B4A 3C4 3C5 3E1B 3E2G6

(72) Inventors RALPH GLEN PARKER JR.
EDWIN RUSSEL KOONS

(19)

(54) IMPROVEMENTS IN AND RELATING TO ELECTRICAL TERMINAL MEANS

(71) We, P. R. MALLORY & Co. INC., a Corporation organized and existing under the laws of the State of Delaware, United States of America, of 3029 East Washington Street, Indianapolis, State of Indiana, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to electrical terminal means, suitable for electrical components. In some electrical components, for example, electrolytic capacitors, it is desirable or necessary to use a terminal of aluminium, but aluminium is not readily solderable. The invention provides a terminal means having at one part a surface of aluminium and at another part a surface which is readily solderable.

The invention includes a terminal means including a core of aluminium, said core having one end at which the aluminium of said core is exposed and an opposite end at which the aluminium core is provided with a plurality of metal-containing layers including a first layer of Ni on the aluminium core and a further layer of a solderable metal on the first layer, the further, solderable, layer being of metal selected from the group consisting of Ag, Au, Zn, In, Cu, Cd, Pt and alloys thereof.

Aluminium is used in electrolytic devices, such as electrolytic capacitors, since it is more resistant to corrosion by a capacitor electrolyte such as a mixture of ammonium pentaborate with ethylene glycol and the like. However, aluminium, when exposed to air, very rapidly forms a film of the oxide on its exposed surfaces; the oxide coated film of aluminium has poor solderability characteristics. On the other hand, most normal metals which can be readily soldered are attacked by the electrolytes. The invention can be used to provide a readily solderable area on a body such as a terminal, of aluminium.

A terminal of this kind can be mounted in a member such as a closure means of insulating material. Such a combination of closure and terminal means can be used in electrical components other than electrolytic capacitors, for example, batteries and the like.

The invention can be used with an electrolytic capacitor which includes a capacitor body of wound aluminium electrode foils and paper separators saturated with a gelatin type electrolyte such as a mixture of ammonium pentaborate with ethylene glycol. The saturated paper separators separate the foils from each other. A housing of aluminium can be used for the capacitor.

In an electrolytic capacitor it is desirable that the upper and external part of the terminal means should be of a solderable metal whereas the lower half of the terminal means within the housing should be of a metal resistant to corrosive attack by the chemicals of the electrolyte, and in this form of the invention there is provided terminal means with an aluminium core having an end covered by a plurality of layers of metal-containing materials to render that end of the aluminium core solderable. The metal-containing layer over the end of the aluminium core serves as a base layer for the application of a solderable metal-containing material. The metal layer over the end of the aluminium core is nickel (Ni). The next metal-containing layer is a solderable metal-containing layer selected from silver (Ag), gold (Au), copper (Cu), cadmium (Cd), platinum (Pt), zinc (Zn), indium (In) or alloys thereof. If the second metal-containing layer is one which oxidises readily when exposed to air, such as Cu, a third layer can be provided over

the second layer, of a metal that is not oxidised by exposure to air. Suitable metals for the third layer include Zn, Sn, Pb, Au, Pd, Pt, Ag, In, Cd and alloys thereof.

The terminal means can be incorporated in an electrically insulating disc-like or other closure by any suitable moulding technique to provide an integrated assembly of the closure and terminal means, suitable for an electrical component. A seal is obtained at the interface between the terminal means and the closure to reduce or prevent leakage of electrolyte from the housing.

Various type of mouldable electrically insulating materials such as thermosetting plastic material, thermoplastic materials, rubber and the like may be used as a material for the closure. A thermoplastic polyester material is preferred for reasons of low cost, availability, workability, rapid curing time, chemical corrosion resistance, and electrical insulating characteristics. In a practical case, the terminal means may have an electrical contact resistance between its opposite ends of less than 0.001 ohm.

Other features and advantages of the invention will appear from the following description of an embodiment thereof, given by way of example, and the accompanying drawings, in which:—

Figure 1 is an enlarged sectional view of a terminal means; and

Figure 2 is a sectional view of a capacitor incorporating a closure and terminal means of Figure 1.

The embodiment of the invention to be described is a combination of closure and terminal means wherein the terminal means includes an aluminium core with an end rendered solderable by covering it with a plurality of metal-containing layers and a solderable metal-containing layer. The initial layer of metal-containing material serves as a base layer for the solderable material which is over the initial layer. One other end of the aluminium core is aluminium and is, therefore, resistant to chemical attack by electrolytes commonly associated with electrical components.

An aluminium resistant to the corrosive action of electrolytes used in capacitors consists essentially, in percentages by weight, of 0.06% Fe, 0.06% Si, 0.005% Cu, 0.01% Mn, 0.01% Mg, 0.02% Zn, 0.01% Ti with 0.01% of minor amounts of other metals, the remainder about 99.8% Al; this aluminium material is designated as type 1188 aluminium by the Aluminium Association Alloy Designation System of the U.S.A. An aluminium core formed from type 1188 aluminium is resistant to chemical attack by an electrolyte containing a mixture of ammonium pentaborate and ethylene glycol. However, type 1188 aluminium and other types of aluminium very rapidly form film of aluminium oxide over their surface upon exposure to air. Aluminium coated with an oxide of aluminium has poor solderability characteristics. To help render the aluminium solderable, a continuous metallic material must be provided over the aluminium, of thickness adequate to prevent exposure to air of the surface of aluminium to be soldered

Referring to Figure 1, terminal means 10 includes an aluminium core 11 with flanges or sections 12 and 13 of increased radius, which key the terminal means in the closure means 14 in which the terminal means is mounted, and aid in preventing the unwanted withdrawal of the terminal means 10 from the closure means 14. Serrations 12′ and 13′ formed in the periphery of sections 12 and 13, respectively, further help to key the terminal means in the closure and minimise rotational displacement of the terminal means 10.

Aluminium core 11 of the terminal means 10 is provided at its upper end 15 with metal-containing layers, to provide a solderable surface 16. More specifically, the end of aluminium core 11 is covered by a first metal-containing layer 17. Preferably, the first metal layer 17 is electrolessly applied nickel. The nickel layer provides on the aluminium core 11 a base layer to which solderable material is then applied. A second metal-containing layer 18, of Ag, Au, Pt, Cd, Cu, Zn, In or alloys thereof is applied over the first metal-containing layer 17. Preferably, the second metal layer 18 is copper. However, copper is oxidisable upon exposure to air, so that if the second layer 18 is of copper, it is preferred that layer 18 be covered by layer 19 of a material which is solderable and which is also resistant to oxidation. Suitable metal-containing materials for layer 19 are Zn, Sn, Pb, Pd, Au, Ag, In, Cd and alloys thereof. Preferably, the solderable layer 19 is an alloy of tin-lead which has excellent solderability characteristics. Of the possible tin-lead alloys, an alloy having about 60 percent by weight of tin and the remainder lead is preferred.

The following is an example of a method useful in providing a terminal means including an aluminium core, with a solderable end.

Example

A core 11 of type 1188 aluminium was cleaned of oil, grease and other foreign matter by vapour de-greasing and solvent cleaning. After cleaning, a conditioning treatment was used to remove the oxide film from the aluminium core 11 and to remove

micro-constituents that may interfere with the formation of a continuous solderable coating on an end of the aluminium core. A layer 17 of 10 to 50 micro-inches of nickel was applied electrolessly to the end by the aluminium core. A layer 18 of 0.0001 to 0.0002 inch of copper was applied over the Ni layer 17. A layer 19 of 0.0002 to 0.0004 inch of a tin-lead alloy was formed over the Cu layer 18 to render solderable the layered end 15 of the aluminium core 11. The tin-lead alloy contained about 60 percent by weight of tin and the remainder lead. The layers 17, 18 and 19 of metal were metallurgically bonded and the tin-lead layer 19 was readily solderable. The upper limit of the thickness of the layers of metals given above could be increased, though no benefits were apparent from such increases in thickness. In some circumstances thick layers of metal-containing material may blister.

Figure 2 shows an electrolytic capacitor 20 incorporating the terminal means 10 and the closure 14 as shown in Figure 1. The capacitor 20 includes a capacitor body 21 and a cup-shaped housing 22. The capacitor body 21 includes alternately wound layers of Kraft paper and aluminium foil electrodes. One of the foil electrodes is the anode electrode of the capacitor 20 and the other foil electrode is the cathode electrode. The foil electrodes of the capacitor 20 are terminated by tabs 23 and 24, respectively. The capacitor body 21 is vacuum impregnated with a suitable electrolyte, such as a mixture of ammonium pentaborate and ethylene glycol, so that the Kraft paper separator is saturated.

The closure means 14 closes the open end of the capacitor housing 22. Terminal means, shown as two in number at 10 and 10′ are carried by the closure means 14 provide electrical connections to the electrodes of the capacitor body 21 through to the exterior of the housing 22.

The terminal means 10 and 10′ shown in Figure 2 are of the same construction; the end 30 of the aluminium core 11 of terminal 10 is suitably attached to the tab 23 connected to one of the electrode foils of capacitor body 21. Electrical connection between the end 30 of the terminal means 10 and the electrode tab 23 is effected by inserting end 30 through an aperture 31 formed in the tab 23, placing a washer 32 over the end 30 and over the tab and then forming a flange 33 by deformation of the end 30 as shown in Figure 1 to couple the terminal means 10 securely to the electrode tab 23. Terminal means 10′ is connected to electrode tab 24 in the same manner.

Prior to assembly of the several parts of capacitor 10, tar based material is introduced to the bottom of housing 22 at 41 to provide support for the lower portion of capacitor body 21. After the tar material 41, the capacitor body 21 and the closure means 14 have been suitably positioned in housing 22, an annular resilient seal 40 is provided by rolling the edge of the housing over the periphery of the closure means. The housing 22 is made of a non-corroding material such as aluminium.

WHAT WE CLAIM IS:—

1. A terminal means including a core of aluminium, said core having one end at which the aluminium of said core is exposed and an opposite end at which the aluminium core is provided with a plurality of metal-containing layers including a first layer of Ni on the aluminium core and a further layer of a solderable metal on the first layer, the further, solderable, layer being of metal selected from the group consisting of Ag, Au, Zn, In, Cu, Cd, Pt and alloys thereof.

2. A terminal means in accordance with claim 1, and including a first layer of Ni, a second layer of Cu, and a third layer of solderable metal selected from the group consisting of Zn, Sn, Pb, Au, Pd, Pt, Ag, In, Cd and alloys thereof.

3. A terminal means in accordance with claim 1 or 2, wherein the contact resistance between opposite ends of the terminal means is not greater than 0.001 ohms.

4. A terminal means in accordance with any of the preceding claims, wherein said core is formed at a region intermediate the exposed aluminium surface and a surface at which the solderable metal is exposed, with parts of different diameter adapted to serve as means for keying said terminal on moulding in a body of mouldable material.

5. A terminal means in accordance with claim 4, wherein said terminal is formed with one or more radially extending flanges.

6. A terminal means in accordance with claim 4 or 5, wherein said terminal is shaped at said region to key said terminal against rotation in the mouldable material.

7. A terminal means in accordance with claim 6, wherein said terminal is formed with longitudinal serrations.

8. A terminal means in accordance with clams 5 and 7, wherein the periphery of said flanges are serrated.

9. A terminal assembly comprising a terminal means in accordance with any of the preceding claims, mounted in a member of insulating material.

10. A terminal assembly in accordance with claim 10, wherein said terminal means is moulded in a member of insulating material.

11. A terminal assembly in accordance with claim 9 or 10, wherein a plurality of

said terminal means are mounted in a common member.

12. An electrolytic capacitor including a housing, and a closure for an opening in said housing, said closure including an assembly in accordance with claim 10 or 11.

13. A capacitor in accordance with claim 12, and comprising a capacitor body and connection tabs extending from said body, said tabs being secured respectively to the terminal means by deformation of projections on the aluminium surface ends of said terminal means.

14. A capacitor in accordance with claim 12 or 13, wherein the electrolyte of said capacitor contains ammonium pentaborate and ethylene glycol.

15. An improved terminal means or assembly or device including such terminal means substantially as described herein with reference to the accompanying drawings.

A. A. THORNTON & CO
Chartered Patent Agents
Northumberland House
303/306 High Holborn
London, W.C.1

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1977.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1 465 096 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

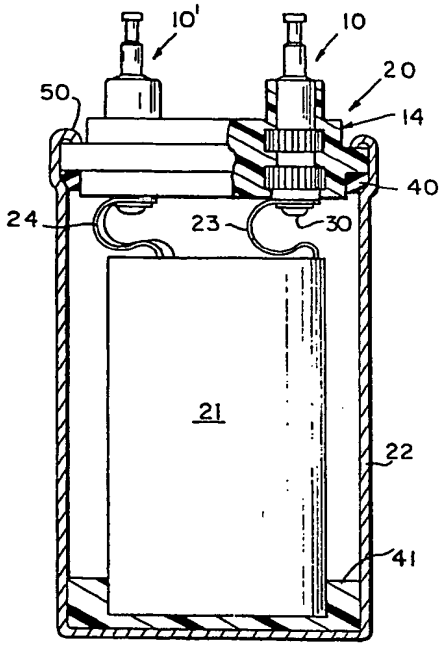

FIG. 2

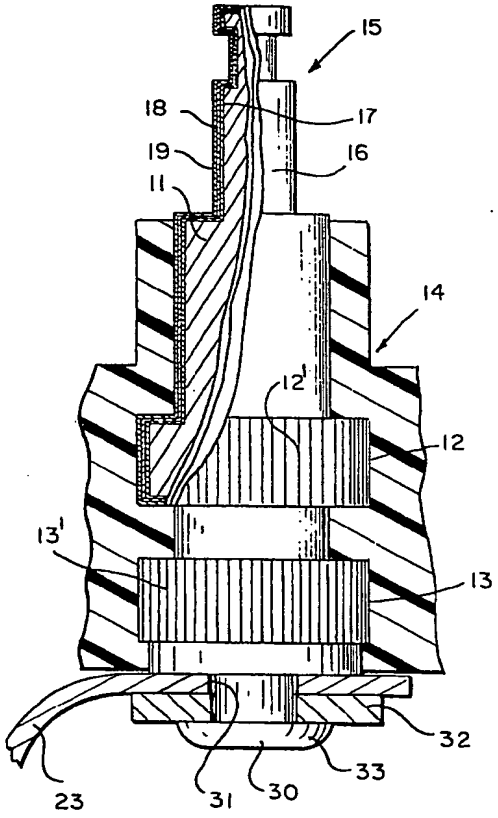

FIG. 1